National Aeronautics and Space Administration

Aeronautics

Compact, Lightweight, CMC-Based Acoustic Liner

Lightweight solution to reduce subsonic jet engine noise

In the wake of recent developments that have reduced fan and jet noise contributions to overall jet-engine noise, aircraft designers are turning their attention toward reducing engine core noise. Innovators at NASA's Glenn and Langley Research Centers are teaming to develop a compact, lightweight acoustic liner based on oxide/oxide ceramic matrix composite (CMC) materials. The CMC acoustic liner has variable-depth channels tuned to reduce broad-spectrum noise in subsonic jet engines. The design of those channels has also been focused on structures that minimize the overall liner thickness. Because the technology uses CMCs, rather than heavy metallic materials, it has the potential to reduce overall engine weight. The oxide/oxide CMC materials are able to withstand extremely high temperatures as well. These CMC acoustic liners can be used in many subsonic jet engines - particularly for next-generation aircraft - to reduce engine core noise. Also, because they can withstand high temperatures, core liners constructed with CMC materials can also provide a thermal barrier.

BENEFITS

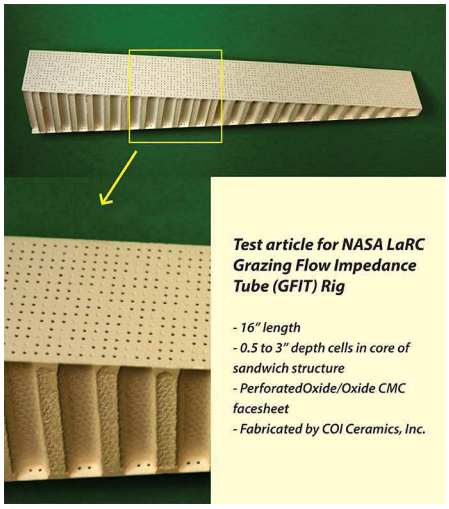
- Effective: Reduces noise over a broad frequency range of 2 to 3 octaves
- Lightweight: Uses CMC materials to reduce weight
- Robust: Offers high-temperature capability

technology solution

THE TECHNOLOGY

NASA researchers are extending an existing oxide/oxide CMC sandwich structure concept that provides mono-tonal noise reduction. That oxide/oxide CMC has a density of about 2.8 g/cc versus the 8.4 g/cc density of a metallic liner made of IN625, thus offering the potential for component weight reduction. The composites have good high-temperature strength and oxidation resistance, allowing them to perform as core liners at temperatures up to 1000°C (1832°F). NASA's innovation uses cells of different lengths or effective lengths within a compact CMC-based liner to achieve broadband noise reduction. NASA has been able to optimize the performance of the proposed acoustic liner by using improved design tools that help reduce noise over a specified frequency range. One such improvement stems from the enhanced understanding of variable-depth liners, including the benefits of alternate channel shapes/designs (curved, bent, etc.). These new designs have opened the door for CMC-based acoustic liners to offer core engine noise reduction in a lighter, more compact package. As a first step toward demonstrating advanced concepts, an oxide/oxide CMC acoustic testing article with different channel lengths was tested. Bulk absorbers could also be used, either in conjunction with or in place of the liners internal chambers, to reduce noise further if desired.

NASA's new CMC-based acoustic liner can reduce jet engine noise while also reducing overall engine weight.



The Oxide/Oxide CMC test article demonstrated acoustic absorption over a range of frequencies.

APPLICATIONS

The technology has several potential applications:

- Subsonic jet engines

PUBLICATIONS

Patent Pending

More Information

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